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CROSS REFERENCE TO RELATED APPLICATIONS

- [0001] ¹⁶ This application is a related to my copending applications entitled: Wireless Transducer Data Capture and Retrieval System for Aircraft, Serial Number 08/745,536, filed on November 12, 1996; Video and Data Capture Retrieval Surveillance System for Aircraft, U.S. Serial Number 08/729,139, filed on October 11, 1996; and Acoustic Catastrophic Event Detection and Data Capture and Retrieval System for Aircraft, U.S. Serial Number 08/738,487, filed on October 28, 1996 now U.S. Patent No. 5,798,458, and my copending applications Ground Based Security Surveillance System for Aircraft and Other Commerical Vehicles; Ground Link with On-Board Security Surveillance System for Aircraft and Other Commercial Vehicles; and, Network Communication Techniques for Security Surveillance and Safety System, filed on even date herewith.

[0002] BACKGROUND OF INVENTION

Field of Invention: The subject invention is generally related to electronic safety and surveillance systems and is specifically directed to a comprehensive multi-media security surveillance system for collecting critical event data and for assessing the location and type of event for distributing the information to key response personnel based on location and capability. One desirable use of the invention is the use of this system for monitoring commercial transports such as aircraft or over-the-road vehicles while in port or terminal, whether taxiing or parked, while both attended and unattended.

Discussion of the Prior Art

- [0003] Security is of ever increasing importance. Using the airlines as an example, global tracking systems are now in place to monitor the flight of the aircraft from the moment it lifts off until it safely lands at its destination. Radar and navigational positioning systems are commonplace both on the aircraft and at the ground tracking stations. All of these electronic systems have increased the overall safety record of commercial traffic to new standards as the number of miles flown continues to escalate.

- [0004] In addition, the on board avionics including electronic monitoring and diagnostic

[0005] However, one area which has been neglected with the ever increasing availability of electronic surveillance is the security of the aircraft or other vehicles or vessels, including, but not limited to, over-the-road vehicles, ships and other commercial transports (collectively referred to as commercial transports), particularly when unattended. Typically, when an aircraft is on the ground, or in port, and unattended the only security provided is the security of the location. If the security of the area in which the commercial transport is stored is breached, the commercial transport is an easy target. In most cases, even the access doors are left open and further, for obvious safety reasons, are designed not to be locked from the outside. Many critical areas of the commercial transport are left exposed such as in an aircraft, by way of example, the baggage hold, the landing gear, the engine housing and critical wing and tail components.

[0007] Another use for the invention is the monitoring of public arena or event such as sporting events, public squares, arenas and the like. This is particularly true with respect to largely attended events such as the Olympics or in areas of high public use and activity such as commercial and public terminals. Such densely populated activities and concurrent concentration of high-value assets have made these activities the increasing targets of terrorist activities. This is in addition to the mechanical and structural failures, injuries to visitors and personnel and other accidents which occur during the normal course of operation.

[0008] The system of the subject invention would provide monitoring and reconstruction of events in such areas. The system would also permit the recording of visual information to provide

[0009] While such a system would be of great benefit to the commercial transport and airline industries in general and to the commercial airlines in particular, there are no integrated systems currently available which adequately meets these needs.

[0010] The subject invention is directed to a comprehensive multi-media safety, tracking and/or surveillance system, which in the preferred form provides both visual and/or audio information as well as critical data such as location, direction, intrusion, fire and/or smoke detection and/or status of environmental conditions and/or asset systems status. It is an important aspect of the invention that the information, once collected, is analyzed and prioritized according to type of event, location and nature of required response for automatically dispatching the proper response.

[0012] Digital wireless telecommunication capability provides for text communications. Digital wireless (such as, by way of example, LAN) based file communication capability permits the transmission of information such as route or flight plans or gate and dock information. As an

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In a typical application, when an alarm from a specific transport is sent to the ground station it will be tagged with the GPS coordinates of the transport. The alarm will also be reported to a security system, typically including a computerized center that distributes the

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[0017] The security computer system will register the GPS location of the selected personnel as well as the location of additional or “back-up” personnel in order to coordinate their movements and actions. The system can then provide essential audio, video and communications to the selected back-up personnel in order to coordinate the entire operation. The coordinates of fixed sensors may also be entered into the system so that personnel can determine the proximity of each available sensor to his GPS location.

[0019] In its preferred form, a plurality of sensor units, which may include at least one video or

[0020] In addition to safety and/or surveillance issues, the comprehensive data collection scheme of the subject invention provides a system permitting enhanced monitoring and/or response to crew generated work orders or re-supply orders, and may even avoid the requirement that the crew order certain supplies. For example, by monitoring the fuel, fresh water, waste water and/or hydraulic levels onboard and transmitting this to a ground station, refueling, water delivery and/or hydraulic fluid check and supply may be initiated by the station crew and prepared for delivery when the commercial transport arrives in port. The performance parameters of the commercial transport may also be monitored and may be utilized for initiating maintenance procedures, for example, even before the commercial transport is in port. Pre-flight or pre-mission checklists may be enhanced or automated by monitoring the critical functions and criteria via the system of the subject invention. The system of the subject invention greatly enhances maintenance procedures and efficiency. Where desired, the system is capable of permitting the commercial transport to carry its detailed maintenance record onboard, permitting full access to such information at remote locations. The maintenance record can be routinely updated or polled from the home based maintenance station using the system's unique uplink capability. The ability to both send and receive information will support remote control of the commercial transport onboard systems such as lighting, strobes, alarm setting/resetting, environmental controls, locking systems, siren or other audible signals, fuel flow, fire detection and the like.

[0022] As an example, current airborne collision avoidance is accomplished by use of a radar transponder. Aircraft position is located by radar “echo” response and altitude by a “reporting

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[0025] The comprehensive multi-media system of the subject invention permits the collection and dissemination of virtually all data associated with personnel, secured areas, assets and support vehicles at any time, both while in port or in service. In the preferred embodiment a combination of sensors systems are used, with sensors being installed within the asset, on its exterior and at ground-based locations for monitoring the transport when is in port. In such areas where ground based systems are not available, the on-board systems still provide useful and enhanced information over the prior art. Likewise, in those areas where unequipped assets enter a system equipped port, the ground based system of the subject invention can communicate via standard ground-to-asset radio to provide useful information such as perimeter surveillance and the like. For example, even without the use of on-board systems, the identification number (such as the tail number on an aircraft), owner, state or country of origin and other identifying information can be matched with available data to provide immediate and accurate identification of a specific

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[0027] Several video cameras may be placed such that the lens of each is aimed through a window opening provided in the fuselage or body in order to provide video imaging of the engines, tail section, and/or landing gear and other functional components of an aircraft. Cameras may be placed throughout the interior of the commercial transport on the flight deck, in the cargo hold, in passenger cabin and/or other desired spaces including on the ground outside the commercial transport. The audio sensors/transducers and/or other sensors and detectors are also strategically located throughout the commercial transport and positioned at strategic locations both internal and external of the fuselage. External sensors based on the ground area surrounding the commercial transport may also be added.

[0029] Within the commercial transport, the system may be hardwired or may use wireless transmission and receiving systems. The wireless system is particularly useful for adapting the system as a retrofit on existing equipment and also provides assurances against disruption of data transmission during structural catastrophes such as fire or airframe breakup. In the preferred

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the terminal, tower and/or safety sites such as security stations and fire stations. Detection of activity or fire can sound local and/or remote alarms and/or dial emergency numbers. The data may also be recorded on the standard recorders provided onboard the commercial transport and/or on ground based recorders of conventional type, digital type or a computer based logging system. The security station has instant live access to all of the image and/or audio signals as they are captured by the sensors, and where used, the commercial transport recorder will make an historic record of the images for archive purposes. Where random access recording techniques are used, such as, by way of example, digital random access memory storage devices, the information may be readily searched for stored information.

If unauthorized personnel breaches the security area and the audio and/or video equipment is activated, signals will be immediately transmitted to the security station. This will give immediate access to information identifying the activity and the personnel involved. Further, in the preferred embodiment of the invention, an alarm system will be activated for securing the immediate area and taking counter measures to tighten security such as remote operation of lights and doors, and respond to a breach of same.

In the one embodiment, information from the plurality of sensors on the transport is synchronized through an on board capture/multiplexing system whereby the plurality of data, including visual image data, may be displayed, recorded, and/or transmitted in either a split screen or serial fashion. A "time-stamp" or chronology signal may also be incorporated in the data scheme. Any signal which is capable of being captured and stored may be monitored in this manner. Utilizing the wireless system of the invention in combination with the battery back-up power supply, it is possible to continue collecting information without using ground power or commercial transport power. This assures that the system will operate even if power is disrupted for any reason such as, by way of example, tampering by unauthorized personnel or by fire. In its simplest form, only triggered (activated) sensors are active, i.e., an activity at the site causes a triggering effect and activates the sensor, and only the signals generated thereby are transmitted to the security station. In such a system, multiplexing of continuous signals is not nearly as critical. The "time-stamp" is particularly useful as an aid in reconstructing the events in a "post-event" investigation.

In the one embodiment, the system includes a plurality of strategically located video image sensors and/or audio sensors, each sensor adapted for transmitting the signals to a multiplexer for

The LAN transceiver is the interface into the LAN. The LAN transceiver can accept software downloads from various system elements to enable the multi-media sensor system to be maintained or upgraded to perform other functions. Other sensors may also be incorporated in the system, such as motion sensors, smoke and/or fire sensors and the like. The system is configured for selectively transmitting all of the data on a “real-time” or “near real-time” basis, i.e., the data is delivered with only delays for processing time such as compression/decompression, multiplexing and the like. The system is also adapted to provide the monitors access to serial, synchronized full screen view of each of the cameras, in sequential viewing, or alternatively to provide split screen or multi-monitor viewing of a plurality of cameras. The system may be hardwired or wireless transmission may be utilized to further minimize the possibility of a malfunction at the onset of a catastrophic occurrence and to make the system more tamper resistant.

[0037] It is a primary object and feature of the subject invention to provide for the monitoring and surveillance of an area and/or asset and collect event data relative to the area and/or asset for prioritizing the data and dispatching an automated appropriate response.

[0039] It is a further object and feature of this invention to provide a comprehensive surveillance and monitoring system supported by a wireless transmission system whereby communication of all data including live video and/or audio transmissions can be transmitted between the transport, ground or base stations, remote sensor systems, remote or mobile monitoring systems and other transports.

- [0040] It is also an object and feature of this invention to monitor the location and types of personnel and support assets available and to distribute collected event information to the appropriate parties.
- [0041] It is a further object and feature of this invention to establish and alert appropriate assets and personnel for response to an event detected as occurring at a monitored area and/or asset.
- [0042] It is another object and feature of this invention to provide tracking capability to assure that a transport stays in an assigned zone while either in route or in the port or terminal.
- [0043] It is a further object and feature of this invention to provide communication capability for monitoring and/or responding to supply needs on board the transport in order to permit support personnel to expedite response and/or re-supply when the transport arrives in port.
- [0044] It is also an object and feature of this invention to provide for monitoring of situational conditions of and surrounding the transport both while in port and while in route.
- [0045] It is yet another object and feature of this invention to provide means for archiving performance parameters for later recall in order to review performance and/or reconstruct events.
- [0046] It is an additional object and feature of this invention to provide a ground surveillance and security system for detecting the breach of commercial transport security while the commercial transport is on the ground or in a port or terminal and is unattended.
- [0047] It is another object and feature of the subject invention to identify that a commercial transport is on the ground and needs to be monitored for tracking its exact location, and its orientation on the ramp.
- [0048] It is also an object and feature of the subject invention to provide a security system, which is integral with the commercial transport for providing ground security.
- [0049] It is a further object and feature of the subject invention to provide communications between the commercial transport and a ground security station to assure commercial transport security while the commercial transport is parked or unattended.
- [0050] It is another object and feature of the subject invention to provide a comprehensive, multi-media data generating, collecting, displaying, transmitting, receiving and/or storage safety and/or surveillance scheme for commercial transport.
- [0051] It is also an object and feature of the subject invention to provide an on ground security system which incorporates the in-flight surveillance system in order to minimize the number of

additional components required to implement the system.

[0052] It is also an object and feature of the subject invention to store video, images, audio and/or transducer data on the commercial transport being protected and/or at the ground security station

[0053] It is yet another object and feature of the subject invention to provide apparatus for permitting ground and/or base personnel to receive video, images, audio information and/or data relating to critical components and areas of a commercial transport and operational data such as dispatch information.

[0054] It is still another object and feature of the invention to permit the monitoring, storing and retrieval of any of a variety of video, images, audio signals and/or performance data by the tracking, surveillance and/or imaging equipment on board the commercial transport.

[0055] Other objects and features of the subject invention will be readily apparent from the accompanying drawings and detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0056] Fig. 1 is a flow diagram of an event triggered automatic response system in accordance with the subject invention.

[0057] Fig. 2 is a flow diagram of a poll asset and update status sequence flow diagram in accordance with the subject invention.

[0058] Fig. 3 is a flow diagram showing the process followed for updating a map system incorporating the data generated by the methods of the subject invention.

[0059] Fig. 4 is process update sequence diagram for mapping the occurrence of and response to an event

[0060] Fig. 5 is an event closing mapping sequence.

[0061] Fig. 6 is a diagrammatic illustration of the selection process techniques for identifying and alerting personnel upon the occurrence and detection of an event requiring response.

[0062] Fig. 7 is a basic diagram of the ground based security and surveillance system of the subject invention.

[0063] Figs. 8a and 8b are diagrams of a simplified, basic camera/transmitter to base station system utilizing an a conventional wireless transmission system between transport and the base station, and adapted for converting generally incompatible systems in order to make the system

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of the subject invention of universal application.

[0064] Figs. 9a and 9b are diagrams of a simplified, basic camera to base station utilizing a digital wireless transmission system such as, by way of example, a digital radio, wireless digital LAN or other wireless communication system.

[0065] Figs. 10a and 10b are diagrams of an expanded system similar to Fig. 9b, but showing use of an on-board hardwired system and on-board wireless system, respectively.

[0066] Fig. 11 is a perspective view of a multimedia camera tracking system for use in connection with the subject invention.

[0067] Fig. 12 is an expanded system incorporating the teachings of Fig. 7, including a remote mobile security unit and utilizing a wireless network such as a wide area network (WAN) or a local area network (LAN) as the signal transmitting and receiving system applied to the mobile components of the system.

[0068] Fig. 13 is an illustration of an aircraft as an exemplary commercial transport and shows the incorporation of on board systems with the comprehensive tracking and monitoring system of the subject invention.

[0069] Fig. 14 shows a typical ground based system.

[0070] Figs. 15 is an expansion of the system shown in Fig. 9, utilizing a remote receiver and monitor station in combination with hardwired ground components, wireless ground components and an aircraft system interface.

[0071] Fig. 16 is a simplified diagrammatic illustration of a wireless LAN or WAN networked system illustrating the versatility of information transmission and monitoring capabilities.

[0072] Fig. 17 is a diagrammatic illustration of the system being used in a taxi protection and/or tracking mode.

[0073] Figs. 18a, 18b and 18c are illustrations of various system configurations for a wireless local area network (LAN) system.

[0074] Fig. 19 is a detailed diagram of the onboard surveillance system for use in connection with transport two-way radio and/or the wireless LAN system of Figs. 15a, 15b and 15c.

[0075] Fig. 20 is an integrated sensor/wireless LAN subsystem using DSP technology.

[0076] Fig. 21 is a diagrammatic illustration of the positioning of tracking sensors on the ramp, particularly well-suited for tracking assets without internal positional or tracking sensors.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0077] It will be readily understood that the various components and features of the subject invention can be utilized in connection with a tracking, security and/or surveillance system for any of a variety of applications. For purposes of brevity, the features of the invention are described in detail herein as applied to commercial aircraft. This is primarily because it is assumed that aircraft systems are likely to incorporate the most complex and comprehensive surveillance systems of the subject invention due to the importance of securing this commercial transport while on the ground and both the importance and complexity of monitoring and tracking same while in port or in route. The system may be scaled up or scaled down depending upon application. For example, land vehicles such as railroad rolling stock or over the road trucks may need only door sensors, motion sensors and brake monitors, whereas aircraft, as described, will require a substantially more comprehensive system in order to provide adequate surveillance. Where the system is employed to secure an area such as a public square, an arena or the like, it is recognized that on-board systems are not employed and that the geographic location is fixed. In the embodiment for aircraft as described in detail herein, the comprehensive surveillance system utilizes the on-board aircraft system in combination with a ground-based wireless system. The wireless configuration can also be applied to the sensors on board the aircraft using the same architecture as described here for the ground based portion of the system. That is, the on board elements may be hardwired, may communicate through wireless radio, or may utilize wireless LAN as herein described, or a combination. The LAN radio provides a wireless LAN connection to other system elements. This is a well-know but evolving technology that allows high bandwidth wireless data transmission between multiple devices. Several different techniques are available from a variety of manufacturers, including Raytheon Systems Corporation, the assignee of the subject invention. Many of these techniques may be utilized in the subject invention.

[0078] The comprehensive system includes various condition sensors, motion and audio detectors, video cameras, light detectors, sound detectors, contact switches, temperature detectors and control systems for controlling light, and sound transmissions to the aircraft. A temperature and/or humidity detector may be used for general monitoring functions such as predicting the icing of the wings in winter conditions, or for fire alarm functions. The temperature detector may be any known form for temperature transducer, such as a PTC, NTC, thermistor, or semiconductor element. More advanced semiconductor elements may be used, such as integrated

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One of the most significant factors in determining the overall complexity of the system is the cost associated with the various sensor components. For example, in certain applications it may be desirable to add a humidity detector or a carbon monoxide detector. A digital camera may be used, or an analog camera may be used in combination with an analog to digital convertor, or digital with internal digitization circuits, or digital compressed with an internal analog to digital convertor and a motion video compressor. In the preferred embodiment, the camera runs at full-motion rates. However, it will be readily understood that the camera can run at lesser rates for still frame or step video applications. In all cases, accurate information can be supplied on a "real-time" basis, i.e., the information can be transmitted, received and acted upon by man or machine in a timely fashion, sometimes with slight delays, to permit adequate response to an event. The video analog/digital convertor is functional to adapt the analog light modulated signal representing the video scene into a digital data stream. This digitizer can run at "real-time" rates for processing full motion video, or could operate at lesser rates for still frame or step video applications. The signal processor/motion video compressor is flexible and will provide various functions depending upon application. For example, the video processor/compressor subsystem can be programmed to perform functions such as motion detection in several well-known manners and methods. Several techniques are utilized to accomplish motion detection, but the most general method involves capturing repeated video frames and comparing differences in those repeated frames over time. Other techniques such as edge analysis, which looks for specific characteristics in the image, and the changes in such characteristics, may also be used. The processor/compressor subsystem can also be used to image process the video for purposes of

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Fig. 1 is a flow chart of the information collection and distribution provided by the system of the subject invention. The subject invention provides the method and apparatus for monitoring a location such as an asset, per se, for example a commercial transport such as aircraft 10 (see Fig. 6) or a strategic area such as a taxiway (see Fig. 21) for the occurrence of an event and collecting information relating to the event. The information is then prioritized and dispatched to various receiving units for initiating an appropriate response based on the prioritization criteria. As specifically shown in Fig. 6, strategic sensors such as cameras 210a and 210b are positioned in predetermined ground based locations, with a geographic location identifier. Additional sensors such as sensor 200 may be placed on board the aircraft 10. This may be an integral on board sensor system such as that disclosed in my aforementioned copending applications and prior patents. This sensor may also include a geographic location transmitter such as a GPS signal generator. With specific reference to Fig. 1, the system of the subject invention is responsive to an event monitored and detected by the various sensors, as indicated at 800 to transmit the event message at 802 to the central system or system wide, as indicated at 804. In the preferred embodiment the event is assigned an event identifier or number and logged for archival purposes, as indicated at 806. The message is then decoded at 808, to identify the location and time of the event, as well as the type of event based on the sensor signal. The event signal is then distributed over the network based on the required appropriate response, the location of personnel and the location of response equipment. For example, turning again to Fig. 6, if the event is indicated to be a fire, the closest personnel 218b may be alerted as well as the closest fire response vehicle 352c. The type of event and the pre-programmed response will generate the appropriate distribution signal from the decoding and control system indicated at 808. For example, personnel 218b (Fig. 6) may send out a signal for additional or backup personnel. This will alert appropriate personnel, as indicated at 810. Different priorities will be established and different methods of distribution will be generated for different types of events, such as, by way of example, a fire 812, unauthorized entry or intrusion of the area or the asset 814, an acoustic event

such as an explosion or gunfire 816, a medical emergency 818, an environmental event 820 and the like. Response messages such as arrival at event location 822, or specific textual input by personnel 824 or other service and system information may also be distributed to and responses generated by the system through the central system decoding computer as indicated at 808. This system permits prioritization of the data based on the source of the data, the location of the event and the type of personnel responding to the data as well as specific response information.

[0081]

The system may also be programmed to periodically poll the various sensor system to routinely check the status of the system and the assets under its supervision, as better illustrated in Fig. 2. The start asset update function 830 may be an automatic sequence or may be manually initiated. With the first step being to define the asset N to be monitored during the sequence, as at 832. As shown at function block 834, the system is set to poll the various assets in sequential or programmed order. Once the asset is selected at 834, the poll is transmitted to the asset at 836 and the system is set to wait for and receive the response see 838 and 840, respectively. The poll includes all of the strategic ground based sensor systems as well as the onboard systems. The polled information is the stored in an archive file for providing a periodic log of the status and location of the asset at any time during its presence in the supervised zones, see 842. Where a response is required, the is stored as indicated at 846. As each asset poll is completed, the system is sequenced at 848 to poll the next asset.

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The following table illustrates a typical asset status poll and table for monitoring a plurality of assets such as those shown in Fig. 6 to determine the location, last time polled, and status of each asset, including personnel, support and response vehicles and commercial transports in the supervised zones.

ASSET STATUS TABLE								
Table	Asset #	Asset Type	Status	Latitided	Longitude	Last Update	Owner	Assoc. Flight
1	001	Security Cruiser	Dispatched	29.533300	-98.457359	22:05:01	Airport Police	
2	004	Security Officer	Idle	29.530379	-98.472465	2:05:10	Airport Police	
3	007	Fire Truck	Idle	29.536475	-98.478815	22:05:11	Airport Fire	
4	010	Security Cruiser	Idle	29.542317	-98.482099	22:05:14	City Police	

As indicated, the asset type is defined, with current status, current location and responsible party. If the asset is associated with a particular scheduled event such as the arrival of a flight, this is also indicated.

Fig. 3 is an example of one type of response using the system of Fig. 1. In this example, the distribution of information relating to a “backup request” response 810 (Fig. 1) is demonstrated. It will be understood that customized responses will be generated for each of the various event signals in accordance with the teachings of the subject invention. Using the “backup request” as an example, it is assumed that personnel 218b (Fig. 6) has approached the aircraft 10 and immediately signals for a backup, activating function 810. The backup signal is then processed at 850, and the various available assets are polled using the process shown in Fig. 2, and as indicated at 852. A distance calculation determining the assets in closest proximity is first calculated, as indicated by function blocks 854, 856 and 858, using the sequence set forth in Fig. 2. The available assets are then sorted by distance from the event, see 860. Using the information created and stored in the Asset Table, the appropriate assets are then dispatched depending on the event signal, see block 862. In the case of a “backup request” additional personnel will be sent such as the nearest police squad car 208a and personnel 218a (see Fig. 6), by transmitting the request to the appropriate assets as at 864. In the preferred embodiment of the invention, a map and route information is also sent to the responding units, see 866. The information is logged and archived in the system, see 868 and transmitted to control centers as indicated at 870 (see Fig. 6). If the first selected response asset is otherwise occupied, i.e., is not

available to respond, see 872, the next most appropriate asset is selected at 874 and dispatched via the sequence starting at 862. If no assets are available, a signal is generated as indicated at 876.

[0084] The event mapping function is demonstrated in Fig. 4, and the event closing mapping function is demonstrated in Fig. 5, respectively. Turning first to Fig. 4, the process event update sequence 880b is initiated when an event occurs. If the event is a fire as indicated in Fig. 6, an appropriate icon for indicating a fire is selected at 882 and the position is determined based on the location data as indicated at function 884. The icon is then placed on the system map as indicated at 886, with appropriate information attached, see 888. This allows all personnel and assets, as well as control centers to monitor the location, response and handling of the event during its life cycle. The mapping function continually updates this and other events by the return loop indicated at 889.

[0085] It is an important feature of the system of the subject invention that not only events are detected, mapped and monitored, but the presence, type and availability of assets to handle the event are also monitored and managed. Thus, movement and deployment of assets are also treated as events.

[0086] Once an event is closed, e.g. the fire of Fig. 6 is extinguished, the map is updated to indicate that the response is completed and the event is handled. The process event closing sequence 890 is shown in Fig. 5. Once an event is closed, the closing map update sequence 890 is initiated and the response information is retrieved at 892 and the event icon is retrieved (or removed from the map) as indicated at 894, with the map being refreshed to its pre-event condition at 896. The return loop is indicated at 898.

[0087] All events can be monitored and the response managed using the system of the present invention, whether the event is a catastrophic occurrence such as the fire of Fig. 6 or it is just a routine event such as the servicing of an aircraft, with assets being deployed in the most efficient and responsive manner. Time events may also be monitored in this manner, with icons appearing as programmed.

[0088] Fig. 6 is an expanded illustration demonstrating the calculation and signaling of appropriate personnel and equipment to the site of an event requiring emergency response. By way of example, assume the tracking cameras 210a and 210b provided a visual signal indicating

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smoke at transport 10. At the same time, the on-board fire and smoke detectors would transmit a signal to the ground based transceiver 212 via the wireless LAN. In addition, the precise location of the transport will be known because of the location signal generated by the transport GPS sensor 200 which is also transmitted over the LAN. The receipt of these various signal will activate several actions. First, all of this information will be transmitted to the ground control tower 216 and to the operations control center 220. The airport fire station 226 will be alerted to the indication of a fire and smoke event and the security center 222 and maintenance center 224 will receive appropriate information. The automated dispatch computer center 225 will monitor the location signal provided by the transport, as well as the location signal of on ground personnel 218a-218c, response vehicles 208a-208c and fire support vehicles 352a-c. By monitoring the type of event that has occurred and both the type and location of available personnel and equipment, the dispatch center can alert and initiate the most efficient appropriate response. The location signals provide sufficient information for the computer system 225 to determine by well-known methods, which asset is closest. For example, ground personnel 218b is closest and would receive the first response signal. If a response vehicle was programmed to respond, vehicle 208a would be first alerted. Likewise, the closest fire truck is truck 352c, which would be the first alerted. As back-up is needed, each of the ground support assets have the capability of signaling for additional support directly back to the dispatch computer. The computer can then select the next closest appropriate asset. The system of the present invention provides a comprehensive, efficient method of collecting, distributing and reacting to critical information to maximize the response of appropriate functional vehicles and personnel on a real time basis while assuring that assignments are prioritized as set by operational personnel. This greatly increases both the timing and the effectiveness of response to critical events.

[0089]

Fig. 7 is an illustration of a basic ground based security and surveillance system for aircraft. The aircraft 10, 10a, 10b...10n will be within the view of video sensors or cameras 210, 210 a...n when on the airport ramp. The video processor/compressor can also be used to perform still image compression to reduce the amount of data required to be transmitted over the network. This can be accomplished by using any suitable image compression algorithm, such as the industry standard JPEG algorithm, wavelet compression, DjVu from AT&T, or other techniques. For full motion video surveillance applications, the compressor 406 may be used to provide bandwidth reduction motion video transmissions. In this application, the amount of data

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By monitoring the identification information from each aircraft, the transmitted video format from the various cameras can be matched to a specific aircraft. The signal is displayed on a monitor at station 18 where it can be viewed and monitored for surveillance and security purposes. In the event of a breach of security, security personnel may be readily dispatched to the correct aircraft using the GPS location signal to define an accurate position of the aircraft. As will be described, the security signals generated by the system of the subject invention may also be logged and inventoried for later play back, which is particularly useful for reconstruction of events. It will be readily understood that the ground components of the system may be hardwired, or other forms of wireless communication, such as, by way of example, a wireless local area network (LAN) could be utilized using radio frequency or optical communications

methods, as will be readily understood by those who are skilled in the art. The system can also be modified to transmit signals from the ground-based station 18 to the various ground sensors and aircraft sensor systems. For example, a camera 210 can receive and respond to remote positioning and zooming signals. Audio warning and activation signals may be sent to the camera locations and to the aircraft to activate audio commands, sirens, lights and the like, which are integral to the system.

[0092]

Figs. 8a and 8b show two different schemes permitting transmission of monitor system data from a transport 10 to a base station monitor 18 using a wireless transmission scheme as indicated at 12. In Fig. 8a, the camera or sensor (for example camera 29) produces a signal which is transmitted as generated by the aircraft transmitter 76 to the base system receiver 14 and then converted at the base system by format convertor 400 for processing or viewing at the base station in its native format. Where desired, the convertor may be at the sensor site as indicated in Fig. 8b. Of course, depending on the various systems being utilized, multiple conversion steps may be utilized. Format conversion capability is required in order to make the system global in nature. For example, the format of each aircraft is often dependent on the country of origin. The United States and Japan generally use an NTSC camera format. France and Russia use SECAM. The United Kingdom typically uses PAL. It is important that the ground or base station be able to recognize and convert any of these formats to a suitable format for processing by the base. Compatibility with multiple, yet different, systems can be automatically accomplished. Instant protocol detection and conversion is shown and described in my copending application, Serial No. 08/816,399, filed on March 14, 1997, entitled: "Instant Protocol Selection Scheme for Electronic Data Transmission via a Distributive Network".

[0093]

Figs. 9a and 9b show a basic wireless digital system. As shown in Fig. 9a, the transport 10 includes a sensor such as the analog camera 29 producing an analog video signal which is converted to a digital signal at convertor 510 and compress at digital compressor 512 for transmission via the wireless transmitter 76 via a digital wireless network 12. The Receiver 14 collects the signal, decompresses it at decompressor 520 for input to the base station monitor 18. The system of Fig. 9b incorporates two-way communication with the basic digital system of Fig. 9a. In this embodiment the transmitter 76 is replaced with a digital transceiver 576 in the transport and the base station receiver 14 is replaced with a digital transceiver 576. This permits command data generated at the input device 501, such as, by way of example, a keyboard or

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[0095] Fig. 11 is a perspective view of a preferred embodiment of a ground based tracking camera sensor 210. In the preferred embodiment, the cameras are adapted to respond to several different types of control signals, including but not limited to:

- [0096] As shown in Fig. 11, the camera system includes a base or mounting bracket 56 for mounting the system at location. The system body 52 is mounted on a tilt mount 54 (y-axis) and pan mount 50 (x-axis), permitting panning (x direction) and tilting (y direction) of the camera for scanning a wide area. A motorized zoom lens 58 is provided (z direction). The preferred embodiment of the system also includes an audio sensor such as directional microphone 60. The audio sensor may be an acoustic transducer, such as a microphone, that collects audio information from the surrounding area. The collected audio can be processed to detect potential emergency conditions such as a gunshot or an explosion, or can be routed directly back to the monitoring

station. Using the sensors of the subject invention, locational origin of an explosion or a gunshot or the like can be triangulated from multiple sensors and the positional origin can be calculated and displayed on maps as an overlay for assisting in pursuit of a perpetrator. The calculated origin can also be correlated by computer to the nearest appropriate emergency assets, base upon their known positions, and those assets may be automatically dispatched. The audio analog/digital convertor adapts the acoustic signal representing the audio environment into a digital data stream. The digitizer runs at real-time rates for real-time audio monitoring. The audio signal processor/compressor has two functions. It is programmed to perform detection in a number of different manners. For example, the processor algorithms can be adjusted to detect impulse noises such as gunshot or a small explosion. Detection of such an event would trigger a specified unique "alarm" for that condition to be transmitted back to other elements of the system. Other types of detection are also possible. By using frequency analysis transforms and signature profiles, noises from engines, door openings or other distinctive noises could be detected when warranted by the situation or condition. For audio surveillance applications, the compressor can also be used to provide bandwidth reduction for audio transmission. In this application, the amount of data representing a real-time audio stream would be reduced by using audio compression techniques such as LPC-10, or other well-known or proprietary algorithms. This allows better bandwidth utilization of the wireless and wired communications channels used by the system.

[0097] Illumination means such as the infrared illuminator 62 permits surveillance during low light no light conditions, without detection by unauthorized personnel. A visual light/strobe light 63 can be turned on by locally detected events, by control signal, or by other system elements such as detection by a companion sensor unit signaling over the LAN. This light can illuminate an area of concern, attract attention of security personnel as a signal, or scare away unauthorized personnel or intruders.

[0098] An integrated GPS receiver 64 is provided for generating location information. This is particularly useful for "drop-and-place" sensors as opposed to permanent sensors. Other features such as a laser range finder 66 that can measure distance to objects/personnel may be incorporated to further expand and enhance the capability of each sensor component. The camera system shown has full 360 degree field of view capability which may be controlled manually by remote control signals, may be programmed to pan the area on a time sequence, may track a

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moving transport using GPS signals from the transport or by using image processing "tracking software" processing the camera image, or may be responsive to and activated by an event occurrence such as from sensors distributed throughout the ramp areas, reporting activity over the LAN, in the well known manner. The range finder 66 permits the tracking system to locate objects in a precise manner and then provide control signals to permit accurate surveillance and monitoring of same, such as zooming the camera or positioning of other sensor elements. An onboard dual GPS systems on the aircraft, with one GPS at the tail and one at the nose, used in conjunction with the GPS system 64 permits the system to determine size, heading and distance to the aircraft being monitored, providing accurate location information and permitting the camera to automatically adjust to monitor the entire aircraft within its range. This permits the selection of the correct camera when multiple cameras are available and permits a wide range of viewing possibilities by being able to determine what portion, if not all, of the aircraft is to be monitored at any given time. In those instances where the aircraft is equipped with a single GPS system, much of this versatility is preserved. However, it will be understood that aircraft size then would have to be determined from the aircraft type or by optical means. When the transport is not equipped with the GPS system, the other sensors such as the range finder/tracking camera or ground level sensors would provide data for camera selection and updating of electronic situational maps. Each sensor and/or camera may incorporate a motion sensor and/or an audio sensor activation device so that the system may be activated when a sound or a motion occurs within the sensor range. The motion detector may comprise any transducer unit that can detect the presence of an intruder and can be a device such as an infrared motion detector, a thermal sensor, an ultrasonic detector, a microwave detector, or any hybrid of two or more of these detectors "fused" together to gain better sensitivity and/or improved detection accuracy. A motion detector convertor may be incorporated to convert the signal from either a single motion detector sensor or a battery of sensors to digital form for processing and/or transmission to other system elements. Multiple elements may be contained within a single sensor system package, or may be fused for multiple sensors in geographically distributed elements with data to be fused being transmitted over the LAN. The motion detector signal processor is adapted for analyzing the sensor data streams from one or more sensors to provide for better sensitivity or improved detection accuracy. Well-known techniques may be implemented to process the transducer data and detect surges over the set thresholds that

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represent detection. The processor/compressor can also be configured to accept input from multiple sensors and process the inputs in a "fused" manner. For example, signals from an infrared detector and ultrasonic detector may be "added" together, then threshold detection performed. This ensures that both an optical and an acoustic return are detected before an alarm condition is broadcast. These and other more sophisticated well known techniques can be used together to gain better sensitivity and/or improved detection accuracy. Detection of such an event would trigger a specified, unique alarm condition to be transmitted back to the other elements of the system.

[0099]

Typically, the sensors will "sense" the presence of unauthorized activity and activate recording from the various audio and/or video equipment and activate alarms. This will initiate the generation of a signal at each of the activated units. The generated signals will then be transmitted to the monitoring and recording equipment, as described, to permit both real-time surveillance and recordation of activity at the site. Motion detection may also be determined using video time/change techniques in the well-known manner.

[0100]

Fig. 12 is an expansion and further refinement of the system of Fig. 7 and is a diagrammatic illustration of the system of the subject invention as configured for a wireless local area network (LAN). In the preferred embodiment the aircraft 10 will include a comprehensive in-flight security system, as better shown in Fig. 13, which is cutaway diagram of a typical commercial airline fuselage 10, with the cargo hold 12, the passenger cabins 15, 16 and the flight deck or cockpit 21 partially visible and a plurality of sensors 19a-n. A more detailed description of this onboard system is shown and described in my aforementioned U.S. Patent No. 5,798,458 and copending applications Serial Numbers: 08/729,139, and 08/745,536. In the subject invention, the currently available sensors may be utilized, without additional enhancements or a number of additional sensors may be added. For example, ground surveillance could be accomplished using only the on-board sensors on the aircraft. In the example, a number of video image sensor devices such as, by way of example, analog video cameras, may be mounted inside the skin of the aircraft and aimed through openings or windows provided in the fuselage to focus on critical components of the aircraft, such as the landing gear cameras 20, 22, the wing engine camera 24 and the tail camera 26. Similar devices or cameras may also be strategically placed throughout the interior of the aircraft, such as the passenger cabin cameras 28, 30, 32, 34, 36, 38, 40, the cargo bay cameras 42, 44, 50 and 52, and the flight deck camera 46. The sensors 19a-n

With specific reference to Fig. 12, in the preferred embodiment the aircraft 10 will also include a nose GPS sensor 200 and a tail GPS sensor 202. The dual GPS sensors permit redundancy, very accurate location and directional positioning of the grounded aircraft, as well as providing information identifying the size of aircraft. An aircraft reference signal (such as tail number) country of origin, owner, and the like, may be incorporated in the transmitted signal so that the monitoring station can identify the aircraft, its location and the security condition thereof by monitoring the signal from that specific aircraft. In the wireless embodiment shown, the aircraft is equipped with a wireless transceiver 204 for transmitting all of the collected signals from the sensors and cameras via the wireless network represented by the wireless communication "cloud" 206. The wireless system shown in Fig. 12 permits transmission not only to the ground control tower and security, but expands the transmission of data to all locations and stations which are part of the wireless system. For example, the signals may be transmitted to a patrolling ground security vehicle 208, a portable monitoring station 218 and/or to the ground security center via the wireless LAN transceiver 212. In addition, signals may be transmitted in either a send or receive mode from any unit in the wireless system to any other unit therein. This is particularly useful when trying to coordinate a response to an incident in a quick response mode.

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[0104] In the preferred embodiment, and as shown in Fig.12, the portable (or drop in place) camera/sensor/link device 210 (see Fig. 11 and accompanying description) is adapted for providing any combination of video surveillance, audio surveillance, motion detection, acoustic detection, sensor positioning capability and wireless link to other system elements. The security vehicle 208 is equipped with a sensor viewing capability as well as an alarm annunciator to alert the operation for quick response. Typically, the transmission of an alarm signal by the aircraft will trigger a link-up at the various monitoring units and will interrupt routinely monitored signals. The alarm signal will include aircraft identification and location data, as well as an indicator of the sensor triggering the initiation of the alarm signal. The alarm location may also be displayed on a "moving map" display, in the well know manner. This permits a quick response team to focus on the incident causing the generation of the alarm signal. In the preferred embodiment of the invention, the alarm at the sensor location is adapted to operate in either an audible or silent mode, depending on the surveillance operation. For example, a warning signal may be broadcast at the location to scare off intruders who breach a restricted area or, in the alternative, the warning signal may only be transmitted and sounded at the base station and/or security vehicles alerting base personnel of a situational change at the monitored zone. Hand held or belt mounted wireless LAN personal security assistants can also be used. These would allow personnel to have access to critical security information while on foot patrol or making rounds, permitting almost immediate response to activating conditions in their vicinity. This would also allow the automatic signaling and dispatch of personnel based upon their identity or based upon their GPS determined location.

[0105] The system wireless LAN transceiver 212 operates as the gateway to the ground based, permanent, wired facilities. A router 228 is provided to bridge the various airport facilities (i.e. an intranet). The router is a typical industry type, as is well known to those skilled in the art, and may be installed in many configurations as required. Where desired, the system may be

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[0107] The use of the dual GPS receivers 200, 202 on the aircraft 10 permits the reporting of the general location of the aircraft on the ramp during taxi when parked whether or not attended. The use of two GPS receivers provides redundancy, better accuracy and orientation information for the aircraft by reporting two distinct position datum signals. It will be readily understood by those skilled in the art that other position signal devices could be utilized such as, by way of example, a single GPS receiver and a magnetic compass (which may have to be corrected for local magnetic fields or interference). By linking the position and orientation information to the ground based centers the location and orientation of the aircraft at all times it is on the ground the aircraft may be closely monitored. Such a system provides ground control transmitting signals showing the location and movement of all aircraft while on the ground, in much the same manner the radar transponders provide air controllers with position and movement data while the aircraft is airborne. This is particularly desirable when the movement of aircraft is portrayed on a map display. Other ground vehicles such as fuel trucks, waste water trucks, baggage handling trains, security vehicles and the like can also be tagged with GPS receivers and LAN transceivers for monitoring their position relative to the aircraft on the ramp. An automated computer system can be operating in the background looking for potential collisions and generating alarm messages if such a conditions is detected. Another automated computer function can track vehicles relating to their authorized areas and issue alarms if security is breached. Yet another function can track the presence or absence of needed services, such as the timely appearance of catering trucks, fuel trucks, wastewater trucks, baggage trains and the like after the arrival of a subject transport. If

any of these required services do not arrive at the transport within a prescribed time period, and "alarm" can be reported over the LAN to the missing services vehicle, and/or to the responsible operations center. This function can be completely automated by a controlling computer system.

[0108]

As shown in Fig. 14, in a typical installation, external sensors 210a-g placed on the ramp in the vicinity of the aircraft to monitor the exterior of the aircraft. For example, a plurality of video cameras 210a and 210b may be placed along the exterior fence 300 of an airport. In additions, cameras may be placed in other strategic locations such as the camera 210c mounted on the terminal building 310 and the remote cameras 210d-n mounted on base units 312 located strategically throughout the airport. When an aircraft 10 is parked on a surveyed area of the airport ramp 314, the various cameras 210 a-n and or other ground based sensors will provide a secure area for the aircraft. Any activity within the range of the cameras may be viewed and monitored.

[0109]

The system of the subject invention is designed such that aircraft onboard sensors and ground-based sensors may be used in combination to provide a comprehensive security system. The ground-based sensors may be used alone to provide basic ground security. The aircraft sensors may be used alone to provide some ground based security with a minimum of modification to existing hardware.

[0110]

In the embodiments shown and described, a multi-media recorder is utilized to record the information for archival purposes. This can be a ground based recorder or the aircraft "black box" recorder 58 (shown as installed in the tail section of the aircraft, see Fig. 13) may be utilized, in the same manner as the current data and voice black boxes (not shown).

[0111]

Audio and video monitors are also provided at the base security station to provide near real-time surveillance. The flight deck monitor and control panel 54 is located on the control panel in the cockpit 21 will also have access to this information. Other monitors may be provided where desired.

[0112]

Turning now to Fig. 15, the system shown is adapted for wireless installation using both onboard aircraft sensors and ground based remote sensors. The system shown relies on the standard on-board radio of aircraft 10 to transfer all aircraft signals to the base station receiver 81 via antenna 81a. In the alternative embodiment of Fig. 15, the ground-based cameras (camera 210d) and a motion sensor 31 are hardwired as shown at 87 to a controller 85. The on-board

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[0114] As shown in Fig. 16, the use of a wireless network provides maximum versatility in the transmission of information and the monitoring and processing capability provided by the system. As indicated in Fig. 16, the transport 10 both sends and receives information between the ground station 18, as previously described and as indicated by the wireless data path A. The transport may also transmit and receive between the fixed sensor station(s) 20 as indicated by wireless data path C. The fixed sensor station is also in direct communication with the ground station as indicated by wireless data path D. It should be understood that permanent installations such as the ground station and the fixed sensor station could be hardwired with one another without departing from the scope and spirit of the invention. In addition, support vehicles such as, by way of example, the baggage train 13 may be equipped with sensors such as location sensors and the data generated by this sensor may be transmitted to the ground station via path B, the monitor station via path E and directly to the transport via path F. The ground station 18, monitor station 20 and transport 10 may also communicate directly with the ground support vehicle 13. For example, if the ground support vehicle comes within a designated "keep-out" or no trespassing zone or is too close to the transport, a proximity sensor or calculated from the GPS data may be utilized to activate and send a warning signal to the ground support vehicle. As

indicated by wireless path G, sensor data may also be communicated between multiple transports 10 and 10a.

[0115]

The comprehensive system of the subject invention not only provides surveillance of the aircraft while at the gate or while unattended, but also provides taxi protection and monitoring. As shown in Fig. 17, when all ground vehicles such as fuel truck 11 and baggage train 13 are outfitted with GPS receivers as well as the aircraft 10, the location and safe distance of each vehicle and the aircraft may be monitored. "Train" type vehicles may be outfitted with two or more GPS receivers to relay the length of the vehicle. Each car can have a separate module. A computerized map of the airport tarmac T, the taxiways P and runway R can be generated showing the position, direction and movement of each vehicle and the aircraft. Predefined keep-out zones "Z" may be established and an alarm may be sounded if the zones are breached. Also, prescribed areas for authorized vehicles may be established and monitored. If a vehicle is outside the designated area, or breaches a zone "Z", an alarm condition will result. This can be prioritized as a cautionary breach, a dangerous breach and so on, depending on proximity of the various vehicles and aircraft to one another. For example, if an aircraft 10 comes too close to a fuel truck 11, alarms in the aircraft, the fuel truck will be activated. In the situation advances to a danger zone, a second alarm condition may alert ground or base personnel that a breach has occurred so the intervention may be initialized. Logging of the "safety" breaches can be made so that safety improvements or training may be implemented based on need.

[0116]

A combination of ground sensors in a matrix on the airport ramp (see sensors 210a-210n in Fig. 14) will scan and monitor vehicles. If a vehicle is detected that does not have a GPS identification authorized for that location and alarm condition will result. For example, if a stray baggage train 13 entered the taxiway area, an alarm would sound indicating that the train 13 has entered an unauthorized area. Emergency and security personnel may also be alerted and dispatched if unauthorized or untagged (no GPS identifier) vehicles are present. This protection scheme could be expanded to include personnel as well as vehicles. For example, the ground vehicle can have a sensor that reads a personnel security token or device such as an encoded digital key. This key information would enable the vehicle and would also be encoded with GPS information and vehicle identification, which is transmitted over the LAN. Security software can then check to determine if the individual is authorized to be present in the vehicle at that time and location, activating an alarm if proper authorization is not confirmed. The vehicle could also

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be immediately shut down. Visual identification of personnel may also be accomplished using the sensor systems of the subject invention.

[0117] Figs. 18a, 18b, and 18c show alternative embodiments permitting use of a wired or wireless LAN transmission system. As shown in Fig. 18a, with a camera sensor C1 for purposes of simplification, the camera C1 generates an analog signal which is converted to a digital signal at convertor 400 and then compressed at the motion video compressor 402. This can be accomplished by industry standard techniques such as motion-JPEG, MPEG, or motion wavelet compression or other current or future compression algorithms. The compressed digital signal is then packetized by the LAN interface 404 and transmitted to the LAN 206 in well-known manner. An analog audio sensor such as microphone 19 is added in Fig. 18b and is supported the dedicated convertor 406 and compressor 408 for input to the multiplexer 410 where the compressed digital audio signal is combined with the compressed digital video signal to produce a complex multi-media signal for packetization by the LAN 404 interface. As shown in Fig. 18c, digital sensors such as motion detector 31 may also be included. The motion detector digital signal does not require conversion and is input directly into the multiplexer 410. As also shown in Fig. 18c, the LAN may be wireless, with a wireless transceiver 412 being incorporated in the system. As previously described, any portion of the system may be wired or wireless depending on ease of installation, mobility requirements and other issues. It may be noted that functions such as the motion video compressor, audio compressor, multiplexer and LAN protocol functions may all be performed as software and could operate on one high speed computer such as a Digital Signal Processor (DSP).

[0118] Turning now to Fig. 19, additional multi-media sensors may be incorporated in the system, as well, and may be wireless or hard wired as appropriate. For example, one or more audio sensors such as a cockpit voice sensor 113 transmit audio signals to multiplexer processor 232. Various function sensors, such as, by way of example, an entire array of intrusion security sensors 115 may also be incorporated in the multi-media system of the subject invention. Where a plurality of such sensors are utilized, it is desirable to provide a local multiplexer system 238 to minimize the amount of duplicative hardware. In the example shown, all of the intrusive security sensors in array 115 require only a single transmitter and antenna as part of a local multiplexer 238 which may then feed a combined signal to the multimedia multiplexer 232. In a wireless system, the security sensor array may also be fully self-contained with an independent

As shown, a variety of image sensor devices may be incorporated, including the video cameras C1, C2, C3...Cn, an advanced imaging device such as the FLIR camera 220, the on board radar 222 and the like. All of these produce a visual signal. In addition, various audio signals may be incorporated utilizing a variety of audio sensor devices, such as a cockpit voice sensor 113, on board radios 224, 226 and the aircraft public address system 228. All of these produce an audio signal. The operational data signals are also incorporated, as previously described, and may include the GPS sensor 72, other navigational sensors 230, the various intrusion sensors 115 and other sensors 125. Thus, the system of the subject invention will accommodate a multiple input, multi-media array incorporating video, audio and digital data signals into a comprehensive database for providing detailed information relating to the aircraft condition at any time.

[0120] Each sensor device signal is introduced into a multi-media multiplexer network 232 which includes a image multiplexer subsystem 234, a dedicated audio multiplexer subsystem 236 and a digital data multiplexer subsystem 238, all of which produce distinctive multiplexed signals which are introduced into a master multiplexer subsystem 232 for producing a combined, comprehensive output signal, as selected, on each of lines 231, 233 and 235. It may also perform decompression functions for compressed command streams and compressed audio or video. The setup and control of the comprehensive output signal is provided by a master controller 241 and input to the multiplexer 232 at 243. The system controller receives commands and streaming audio information from other system elements and distributes them to controlled devices. The controller performs a command decoding function to sort out command and data streams directed toward specific devices and components of the system.

[0121] The visual and textual data is available at a display monitor 54. The audio signal is output at 237 to an audio output system such as amplified speaker 240. All of the data, including all video, audio and digital data will be recorded on the recorder system 70. Information representing audio, video, sensor data, and other vital digital data is fed from the multimedia multiplexer to the recorder 70 over the signal lines 233. It should be noted that the multimedia multiplexer may be analog, digital, or packetized digital data type, or a combination of technologies based on application. Where desired, selected portions of the systems data on the aircraft may be downlinked to the ground or base station 18 (see Fig. 8) as the combined, comprehensive output signal on line 246 to be transmitted to the ground station via the aircraft radio system 80 and the

[0122] Where desired, a light level detector may be used for detecting light conditions such as the ambient lighting or transient conditions such as vehicle headlights or a flashlight. The light detector analog/digital convertor adapts the ambient light levels into a digital data stream. this digitizer runs at real-time rates for real-time illumination monitoring. The light detector signal processor can be programmed to look for profiles such as rapidly increasing light conditions that may indicate a vehicle or a flashlight as opposed to the rising or setting sun. Detection of such an event would trigger a specified unique alarm condition to be transmitted back to other elements of the system.

[0123] External contact sensors may also be deployed and a condition change may be detected and processed by the contact signal processor. These may be devices such as door contacts, special motion detectors such as trip wires and the like, floor pads and the like which can be connected, either by wires or wireless means to the contact detection circuit. Detection of such an event would trigger a specified alarm condition to be transmitted back to other elements of the system.

[0124] An audible speaker system can also be provided in the preferred embodiment and can provide numerous audio outputs such as, by way of example, voice output or a siren. This is a multi-function device and can be activated by local detection events, and by other system elements such as detection by a companion sensor unit signaling over the wireless system. The siren can indicate an area of concern, serve as a signal to security personnel and/or scare off intruders. The audible speaker can also be used to provide voice instructions or signals based on local detection events, and by other system elements. The controller produces the synthesized or stored voice signals. The controller can be programmed or downloaded over the wireless system. The speaker system can also be used as a paging system by sending digitized or compressed voice

[illegible]

[0130]

[0131]

While certain features and embodiments of the invention have been described in detail herein, it will be readily understood that the invention encompasses all modifications and enhancements within the scope and spirit of the following claims.